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Head Direction Signal Contributes to Landmark Navigation on the Radial Arm Maze

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Introduction

- The head direction signal is thought to be important for spatial performance.[1]
- Otoconia-deficient *tilted* mice have intact brains with degraded head direction cell signals.[2]

Aim

To determine whether the degraded head direction signal of *tilted* mice is associated with landmark navigation.

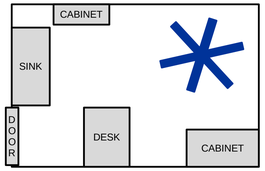
Method

Subjects

- Male homozygous *tilted* mice and heterozygous littermate controls

Apparatus

- 6-arm Radial Maze in open room



Procedure

1. Pre-exploration:

- All arms baited; maze in a different room
- One 10-min trial per day, for two days

2. Training:

Landmark Navigation:

- Two arms baited
- Four trials per day, for ten days

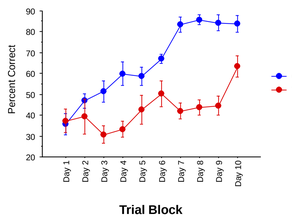
Cued Navigation

- Two arms baited
- Four trials per day, for ten days
- Cues place at the end of both baited arms

Results

Landmark Navigation

Percentage of Correct Arm Choices

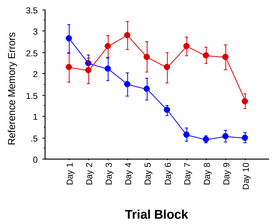


Group: $F(1,12) = 64.8$, $p < .01$

Trial Block: $F(9,108) = 14.2$, $p < .01$

Group x Trial Block: $F(9,108) = 5.06$, $p < .01$

Reference Memory Errors

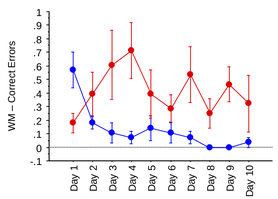


Group: $F(1,12) = 38.9$, $p < .01$

Trial Block: $F(9,108) = 8.80$, $p < .01$

Group x Trial Block: $F(9,108) = 7.02$, $p < .01$

Working Memory - Correct

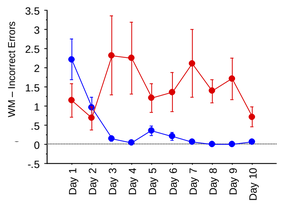


Group: $F(1,12) = 11.1$, $p < .01$

Trial Block (n.s.): $F(9,108) = 1.07$, $p = .39$

Group x Trial Block: $F(9,108) = 2.68$, $p < .01$

Working Memory - Incorrect



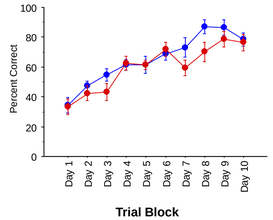
Group: $F(1,12) = 5.73$, $p = .03$

Trial Block: $F(9,108) = 2.01$, $p = .04$

Group x Trial Block: $F(9,108) = 4.78$, $p < .01$

Cued Navigation

Percentage of Correct Arm Choices

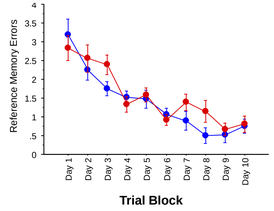


Group: $F(1,16) = 2.13$, $p = .16$

Trial Block: $F(9,144) = 25.23$, $p < .01$

Group x Trial Block: $F(9,144) = 1.51$, $p = .33$

Reference Memory Errors

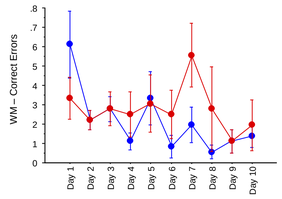


Group: $F(1,16) = 2.99$, $p = .32$

Trial Block: $F(9,144) = 138.38$, $p < .01$

Group x Trial Block: $F(9,144) = 16.02$, $p = .32$

Working Memory - Correct

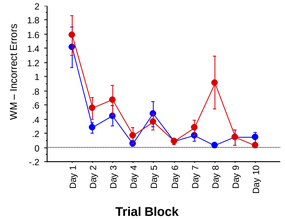


Group: $F(1,16) = 1.64$, $p = .22$

Trial Block: $F(9,144) = 2.09$, $p < .03$

Group x Trial Block: $F(9,144) = 1.20$, $p = .30$

Working Memory - Incorrect



Group: $F(1,16) = 2.99$, $p = .10$

Trial Block: $F(9,144) = 15.38$, $p < .01$

Group x Trial Block: $F(9,144) = 1.78$, $p = .08$

Summary

All types of errors occurred more frequently in *tilted* mice than in control mice on the landmark navigation task, but not the cued navigation task.

Conclusion

Head direction signal degradation is associated with landmark navigation deficits.

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